Serial No.: 10/540,110
Atty. Docket No.: P70551US0

IN THE CLAIMS:

Please amend the claims as follows:

1. (Currently Amended) A method of determining a ~~the~~ blood flow rate Q_F in a blood-carrying line ~~(40)~~ that is coupled to an extracorporeal blood treatment device through an arterial line and a venous line, ~~of which~~ a portion of blood in said blood-carrying line being ~~a portion is~~ branched off at a first location ~~(12)~~ through said ~~an~~ arterial line ~~(14)~~ and being ~~through a venous line (15) and is~~ returned to said blood-carrying line at a second location ~~(13)~~ through said venous line such that said portion of blood passes from said arterial line to said extracorporeal blood treatment device and then to said venous line, the method comprising the steps of:

~~whereby~~ determining a physicochemical variable Y of the blood, which is constant over a period of time for a measurement interval, ~~is determined~~ in the arterial line ~~(14)~~ upstream of said extracorporeal blood treatment device as having ~~the~~ value Y_A and ~~is determined~~ in the venous line ~~(15)~~ downstream of said extracorporeal blood treatment device as having ~~the~~ value Y_V,

determining a ~~the~~ net rate dX/dt of a variable X derived from the physicochemical variable Y into or out of the

blood-carrying line ~~(40)~~ during the measurement interval ~~is determined~~ from the values Y_A and Y_V as a ~~the~~ difference between ~~the~~ rate dX_A/dt as measured in blood removed from the blood-carrying line through the arterial line ~~(14)~~ and ~~the~~ rate dX_V/dt as measured in blood supplied back to the blood-carrying line through the venous line ~~(15)~~, and

using the net rate dX/dt ~~is used~~ to determine the blood flow rate Q_F in said blood-carrying line.

2. (Currently Amended) The method according to claim 1, ~~characterized in that the~~ wherein a blood flow rate Q_B is determined in the arterial line ~~(14)~~ and in the venous line ~~(15)~~ for the determination of the rate removed dX_A/dt and the rate supplied dX_V/dt.

3. (Currently Amended) The method according to claim 2, wherein ~~characterized in that~~ the physicochemical variable Y is the thermal energy per unit of volume of blood, and the variable X, which is derived from Y ~~it~~, denotes the thermal energy E of the blood in the blood-carrying line ~~(40)~~.

4. (Currently Amended) The method according to claim 3, wherein a temperature ~~characterized in that the temperatures~~ T_A in the arterial line ~~(14)~~ and a temperature T_V in the venous line ~~(15)~~ are determined for the determination of the net thermal energy rate dE/dT, and the net energy rate is determined on the basis of the equation

$$\frac{dE}{dt} = \frac{dE_V}{dt} - \frac{dE_A}{dt} = c_E \rho_B Q_B (T_V - T_A)$$

where c_E is the specific thermal capacity and ρ_B is the density of the blood.

5. (Currently Amended) The method according to claim 2, wherein ~~characterized in that~~ the physicochemical variable Y is ~~the~~ a concentration c of a substance in blood, and X is a ~~the~~ quantity C of the substance in the blood-carrying line ~~(40)~~.

6. (Currently Amended) The method according to claim 5, wherein ~~characterized in that~~ the concentrations c_A of the substance in the arterial line ~~(14)~~ and c_V in the venous line ~~(15)~~ are determined for the determination of ~~the~~ a net substance quantity rate dC/dt, and the net substance quantity rate is determined according to the equation:

$$\frac{dC}{dt} = \frac{dC_V}{dt} - \frac{dC_A}{dt} = Q_B (c_V - c_A)$$

7. (Currently Amended) The method according to claim 1, <u>wherein</u> ~~characterized in that~~ the arterial line ~~(14)~~ branches off from the blood-carrying line ~~(40)~~ upstream from the venous line ~~(15)~~, and the blood flow rate Q_F is determined on the basis of the equation:

$$Q_F = \frac{\frac{dX}{dt}}{Y_V - Y_B}$$

where Y_B is the physicochemical variable in the blood-carrying line ~~(40)~~ upstream from <u>a</u> ~~the~~ branch ~~(12)~~ in the arterial line ~~(14)~~.

8. (Currently Amended) The method according to claim 2, <u>wherein</u> ~~characterized in that~~ the arterial line ~~(14)~~ branches off from the blood-carrying line ~~(40)~~ downstream from the venous line ~~(15)~~, where the net rate is designated as dX_{rec}/dt, and the physicochemical variable in the venous line is designated as $Y_{V,rec}$, and the blood flow rate Q_F is determined on the basis of the equation:

$$Q_F = \frac{Q_B \frac{dX_{rec}}{dt}}{Q_B(Y_{V,rec} - Y_B) - \frac{dX_{rec}}{dt}}$$

where X_B is the physicochemical variable in the blood-carrying line ~~(40)~~ upstream from ~~the~~ <u>a</u> branch ~~(13)~~ in the venous line ~~(15)~~.

9. (Currently Amended) The method according to claim 2, wherein ~~characterized in that~~ both the net rate dX/dt with the upstream branch in the arterial line ~~(14)~~ relative to the venous line ~~(15)~~ from the blood-carrying line ~~(40)~~ as well as the net rate dX_{rec}/dt with a downstream branch in the arterial line ~~(14)~~ relative to the venous line ~~(15)~~ from the blood-carrying line ~~(40)~~ are determined at the same blood flow rate Q_B, and the blood flow rate Q_F is determined according to the following equation:

$$Q_F = \frac{Z}{1-Z} Q_B \qquad \text{where} \qquad Z = \frac{\frac{dX_{rec}}{dt}}{\frac{dX}{dt}} \frac{Y_V - Y_A}{Y_{V,rec} - Y_A}$$

10. (Currently Amended) A device for measuring ~~the~~ blood flow in a blood-carrying line ~~(40)~~, comprising:

an arterial line ~~(14)~~ branching off from the blood-carrying line ~~(40) with~~ through which blood is removed from the blood-carrying line;

a venous line ~~(15)~~ opening into the blood-carrying line ~~(40) with~~ through which blood is supplied to the blood-carrying line;

arterial measurement means ~~(20)~~ and venous measurement means ~~(22)~~ for determining a physicochemical variable Y of the

blood in the arterial line ~~(14)~~ with the value Y_A and in the venous line ~~(15)~~ with the value Y_V, ~~Y_B,~~ these variables being constant over a period of time for a measurement interval;

an analyzer unit ~~(27)~~ connected to the arterial measurement means ~~(20)~~ and the venous measurement means ~~(22)~~, ~~this~~ said analyzer unit being configured to determine ~~suitable for determining the~~ a net rate dX/dt of a variable X derived from the physicochemical variable Y into or from the blood-carrying line ~~(40)~~ during the measurement interval as the difference between ~~the~~ a rate dX_A/dt as measured in blood removed from the blood-carrying line through the arterial line ~~(14)~~ and ~~the~~ a rate dX_V/dt as measured in blood supplied back to the blood-carrying line through the venous line ~~(15)~~ from the values Y_A and Y_V, said analyzer unit being further configured to use ~~and it is also suitable for using~~ the net rate dX/dt to determine the blood flow rate Q_F in said blood-carrying line.

11. (Currently Amended) The device according to claim 10, ~~characterized in that~~ wherein means ~~(18)~~ are provided for detecting and/or adjusting ~~the~~ a blood flow rate Q_B in the arterial line ~~(14)~~ and in the venous line ~~(15)~~.

12. (Currently Amended) The device according to claim 11, ~~characterized in that~~ wherein the means for detecting the blood flow rate Q_B ~~consist of~~ includes a flow sensor, which is connected to the analyzer unit ~~(27)~~.

13. (Currently Amended) The device according to claim 12, ~~characterized in that~~ wherein the means for detecting the blood flow rate Q_B ~~consist of~~ includes a control unit ~~(18)~~ which is used for setting a delivery rate of a blood pump ~~(16)~~, which is situated in the arterial line ~~(14)~~ and/or the venous line ~~(15)~~ and is connected to the analyzer unit ~~(27)~~.

14. (Currently Amended) The device according to claim 11, ~~characterized in that~~ wherein the physicochemical variable Y denotes a ~~the~~ thermal energy per unit of volume of blood, and the variable X derived therefrom denotes a ~~the~~ thermal energy E of the blood in the blood-carrying line ~~(40)~~.

15. (Currently Amended) The ~~method~~ device according to claim 14, wherein ~~characterized in that~~ the measurement means ~~(20, 22) in the arterial line~~ includes a temperature sensor (T_A) in the arterial line and a temperature sensor ~~the venous line~~ (T_V) in the

venous line ~~are temperature sensors~~ for determining the net thermal energy rate dE/dt, and the analyzer unit ~~(27)~~ is configured to determine ~~suitable for determining~~ the net thermal energy rate by using the equation:

$$\frac{dE}{dt} = \frac{dE_V}{dt} - \frac{dE_A}{dt} = c_E \rho_B Q_B (T_V - T_A)$$

where c_E is the specific thermal capacity, and ρ_B is the density of blood.

16. (Currently Amended) The device according to claim 11, ~~characterized in that~~ wherein the physicochemical variable is ~~the~~ a concentration c of a substance in the blood, and X is ~~the~~ a quantity C of ~~this~~ said substance in the blood-carrying line ~~(40)~~.

17. (Currently Amended) The device according to claim 16, ~~characterized in that~~ wherein to determine the net substance quantity dC/dt, the measurement means ~~(20, 22)~~ includes a concentration sensor ~~in the arterial line~~ (c_A) in the arterial line and a concentration sensor ~~in the venous line~~ (c_V) in the venous line ~~are concentration sensors~~, and the analyzer unit ~~(27)~~ is suitable for determining the net substance quantity rate on the basis of the equation:

$$\frac{dC}{dt} = \frac{dC_V}{dt} - \frac{dC_A}{dt} = Q_B (c_V - c_A)$$

18. (Currently Amended) The device according to claim 10, ~~characterized in that~~ wherein the arterial line ~~(14)~~ branches off from the blood-carrying line ~~(40)~~ upstream from the venous ~~vinous~~ line ~~(15)~~, and the analyzer unit ~~(27)~~ is configured to perform ~~suitable for perfoming~~ a determination of the blood flow rate Q_F on the basis of the equation:

$$Q_F = \frac{\frac{dX}{dt}}{Y_V - Y_B}$$

where Y_B is the physicochemical variable in the blood-carrying line ~~(40)~~ upstream from the branch ~~(12)~~ in the arterial line ~~(14)~~.

19. (Currently Amended) The device according to claim 11, ~~characterized in that~~ wherein the arterial line ~~(14)~~ branches off from the blood-carrying line ~~(40)~~ upstream from the venous line ~~(15)~~, whereby the net rate is designated as dX_{rec}/dt and the physicochemical variable in the venous line is designated as $Y_{V,rec}$, and the analyzer unit ~~(27)~~ is configured to perform ~~suitable for performing~~ a determination of the blood flow rate Q_F by using the equation:

$$Q_F = \frac{Q_B \frac{dX_{rec}}{dt}}{Q_B(Y_{V,rec} - Y_B) - \frac{dX_{rec}}{dt}}$$

where Y_B is the physicochemical variable in the blood-carrying line ~~(40)~~ upstream from a ~~the~~ branch ~~(13) and~~ in the venous line ~~(15)~~.

20. (Currently Amended) The device according to claim 11, ~~characterized in that~~ wherein the analyzer unit ~~(27)~~ is configured to determine ~~suitable for determining~~ both the net rate dX/dt with an upstream branch in the arterial line ~~(14)~~ with respect to the venous line ~~(15)~~ from the blood-carrying line ~~(40)~~ as well as the net rate dX_{rec}/dt with a downstream branch in the arterial line ~~(12)~~ with respect to the venous line ~~(15)~~ from the blood-carrying line ~~(40)~~ at the same blood flow rate Q_B, and then from that determining the blood flow rate Q_F according to the following equation:

$$Q_F = \frac{Z}{1-Z} Q_B \quad \text{where} \quad Z = \frac{\frac{dX_{rec}}{dt}}{\frac{dX}{dt}} \frac{Y_V - Y_A}{Y_{V,rec} - Y_A}.$$

21. The device according to claim 10, characterized in that the arterial line ~~(14)~~ and the venous line ~~(15)~~ are part of an extracorporeal blood circulation system ~~(2)~~ of a blood treatment device.

22. (Currently Amended) The device according to claim 21, ~~characterized in that~~ wherein the blood treatment device is a hemodialysis device.

23. (Currently Amended) The device according to claim 21, ~~characterized in that~~ wherein the blood flow rate Q_F to be determined is the blood flow in a blood vessel~~, in particular an arteriovenous fistula or a shunt,~~ in a patient.

24. (Currently Amended) The device according to claim 10, ~~characterized in that~~ wherein device has a display unit ~~(28)~~ suitable for displaying the blood flow rate Q_F.